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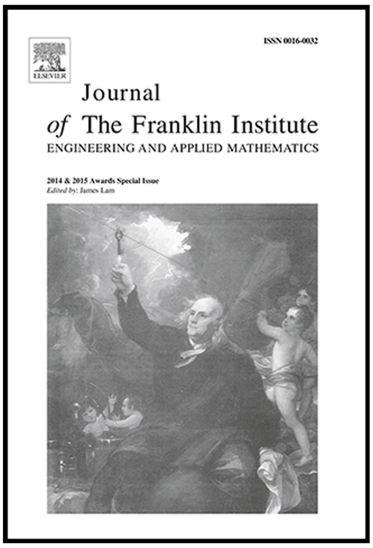

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Delay-range-dependent static anti-windup compensator design for nonlinear systems subjected to input-delay and saturation

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Abstract

This paper presents the novel delay-range-dependent schemes for computing the static anti-windup compensator (AWC) gain for nonlinear systems with input time-delay and saturation constraints. By utilizing the Lyapunov-Krasovskii functional, sector conditions, Lipschitz inequality, and Wirtinger-based inequality and by employing the range of input lags, time-derivative bound of delay, and $\mathcal{L}_2$ gain reduction for exogenous input, sufficient conditions are derived in order to ensure global and local stability of the overall closed-loop system. In contrast to the conventional approaches, the resulting AWC design methodology can be applied to nonlinear systems with input delays (due to distant placement of a system from the controller), supports static AWC design (computationally straightforward for implementation), and employs range of the input delay (rather than trivial selection of the lower delay bound as zero). Simulations are carried out for two electro-mechanical systems, namely, a nonlinear DC motor and a nonlinear flexible-link robot under input time-delay and input saturation constraints.

Keywords: Static anti-windup compensator, input time-delay, delay-range-dependent condition, nonlinear systems, sector condition

1. Introduction

Input saturation nonlinearity is presented in nearly all real-world practical systems because an actuator cannot convey unconstrained power to a system. This actuator bounded input limitation can cause windup consequences leading to performance abasement and even instability of the closed-loop system. The controller design without considering the saturation effects can result in undesirable outcomes such as oscillations, high overshoot, undershoot, lag, large settling time, and some times even instability. Anti-windup compensator (AWC) design has been remained an invoking problem among the control community

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